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Menangle Virus Infection

*Pig Paramyxovirus Infection,
Porcine Paramyxovirus Infection*

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Importance

Menangle virus infection is a recently emerged, zoonotic disease of swine, currently limited to one outbreak in Menangle, New South Wales, Australia. Menangle virus appears to be maintained asymptotically in fruit bat (flying fox) populations, but it can emerge to become established in some swine herds. Sows infected with Menangle virus have a reduced farrowing rate and give birth to smaller litters with fewer live piglets. Affected litters have an increased number of mummified or stillborn piglets, some with congenital defects of the skeletal and neurological systems. This virus is also zoonotic: during the only known outbreak, two people who were in close contact with infected pigs developed a severe but self-limited influenza-like disease.

Etiology

Menangle virus is one of several recently discovered RNA viruses in the family Paramyxoviridae. Although this virus has not been officially assigned to a genus, molecular characterization has placed it in the genus *Rubulavirus*. Menangle virus is closely related to Tioman virus, a rubulavirus recently found in fruit bats on Tioman Island, Malaysia.

Species Affected

Fruit bats of the genus *Pteropus* appear to be the reservoir hosts. Seropositive species include *Pteropus poliocephalus* (gray-headed flying fox), *P. alecto* (black fruit bat) and *P. conspicillatus* (spectacled fruit bat). Menangle virus infections have also been reported in pigs and humans. Cattle, sheep, birds, rodents, cats and a dog tested near affected pig farms were seronegative.

Geographic Distribution

Infected pigs have been reported only from New South Wales, Australia. Seropositive fruit bats have been found in New South Wales and Queensland, and may exist in other parts of Australia.

Transmission

Fruit bats of the genus *Pteropus* seem to be the reservoir hosts for Menangle virus. Although at least three species of bats are seropositive, the virus has not been recovered from these animals, and the method of transmission between bats, or from bats to pigs, is unknown. However, pigs on one infected farm were frequently exposed to fruit bat feces and urine, and these excretions were thought to be the source of this outbreak.

Transmission of Menangle virus between pigs is relatively slow and seems to require close contact; in one building where sows were kept in pens, it was several weeks before all sows were affected. Fecal-oral or urinary-oral transmission is the most likely route of spread. Epidemiological studies suggest that Menangle virus is transmitted between farms in infected animals. There is no evidence of persistent infections, and long-term shedding does not seem to occur.

Menangle virus infections have been reported in humans who had close direct contact with infected animals. One person reported being splashed with amniotic fluid or blood during births, while the other reported performing necropsies without gloves or protective eyewear. These individuals may have been infected when abraded skin or mucous membranes became contaminated with the virus.

Transmission on fomites is possible, but epidemiological evidence suggests that virus survival in the environment is short. When sentinel pigs were placed in an uncleaned area three days after removing infected pigs, the sentinel pigs did not seroconvert.

Incubation Period

The incubation period is unknown. Menangle virus appears to cross the placenta early in gestation, then spreads gradually from fetus to fetus. Although some animals abort, other infections do not become apparent until the sow gives birth.

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Clinical Signs

Clinical signs are limited to decreased reproductive performance in sows, and deaths and deformities in fetuses. Sows have reduced farrowing rates and give birth to smaller litters with fewer live piglets. Affected litters can contain a mixture of mummified, autolyzed and fresh stillborn piglets, with a few normal live piglets. Some dead piglets have deformities of the skeletal or nervous systems, which may include arthrogryposis, brachygnathia (shortened jaw), and degeneration of the central nervous system (CNS). Some sows may abort. Many sows return to estrus approximately 28 days after mating, suggestive of early death of the entire litter. Others may remain in a state of pseudopregnancy for more than 60 days. Menangle virus infections are subclinical in postnatal animals, and sows that abort do not appear to be ill. Piglets born alive also seem to be unaffected.

Post Mortem Lesions [Click to view images](#)

Fetuses from affected litters may be stillborn, aborted, mummified, semi-mummified or autolyzed; some litters also include normal live piglets. Mummified fetuses vary in size, and are at a gestation age of 30 days or older. Stillborn, mummified and aborted fetuses may have skeletal and/or neurological deformities; these congenital defects occur in approximately one third of all litters. In the CNS, there may be slight to severe degeneration of the brain and/or spinal cord. The cerebral hemispheres, brain stem, spinal cord and particularly the cerebellum may be noticeably smaller than normal. In some fetuses, the brain and spinal cord may be nearly absent. Hydranencephaly can also be seen. Reported skeletal deformities include arthrogryposis, craniofacial abnormalities such as brachygnathia and doming of the skull, and scoliosis or kyphosis. Occasionally, fibrinous body cavity effusions and pulmonary hypoplasia may also be seen. CNS lesions are more common and severe during the earlier stages of an outbreak, but skeletal lesions do not change in frequency as the outbreak progresses. Epicardial hemorrhages and subcutaneous edema may also be found in some piglets. No lesions have been seen in piglets born alive or other postnatal pigs.

Histologically, the CNS lesions are characterized by degeneration and necrosis of the gray and white matter with infiltrations of inflammatory cells. Eosinophilic to amphophilic intranuclear and intracytoplasmic inclusion bodies may be found in these neurons. Nonsuppurative myocarditis, multifocal meningitis or hepatitis can also occur in some piglets.

Morbidity and Mortality

Menangle virus appears to circulate asymptomatically in fruit bat populations. In one survey, 33% of *P. poliocephalus*, 55% of *P. alecto* and 40% of *P. conspicillatus* were seropositive in Australia. No antibodies

were found in fifteen *P. scapulatus* (little red fruit bats) living near the affected farm.

Only one outbreak has been reported in pigs, and the risk of transmission to these animals may be low. The single outbreak occurred in 1997, and affected three farms including a 3000-sow farrow-to-finish pig farm located near a fruit bat colony, and two associated growing farms. Clinical signs were reported only on the farrow-to-finish farm, but infected pigs were found on all three farms. During this outbreak, the weekly farrowing rate decreased from an expected 80-82% to as low as 38%, with an average decrease from 82% to 60% between mid-April and September 1997. Overall, the number of live piglets declined in 27% of litters. During some weeks, up to 45% of the litters were affected. No disease was seen in postnatal animals of any age; however, 96% of sows on the breeding farm and 88% of the 25-week old pigs on the grower farms were seropositive. Active infections were not found on other Australian farms or in feral pigs in the affected region; however, two archived serum samples from another farm in North South Wales were seropositive. Although this farm is also close to a fruit bat colony, other serum samples from this herd were seronegative.

Clinical signs seem to occur only in naïve herds; once the infection became endemic in the farrow-to-finish herd, no further reproductive failures occurred. Menangle virus seems to be maintained in a herd by infecting young pigs when they lose their maternal immunity at approximately 14-16 weeks of age. These pigs have usually developed good immunity to the virus by the time they enter the breeding herd, and are no longer susceptible to disease. By infecting each new crop of young pigs, Menangle virus can become endemic in larger herds. It is unlikely to persist in small herds where there are insufficient numbers of young susceptible hosts, as pigs develop good immunity after infection, persistent infections are not seen, and the virus appears to be short-lived in the environment.

Diagnosis

Clinical

Menangle virus infection should be considered when litters contain an increased proportion of mummified and/or stillborn piglets and reduced numbers of healthy live piglets. This possibility is strengthened if congenital skeletal and/or neurologic defects are seen in dead piglets, but these lesions are found in only one-third of affected litters. Postnatal pigs, including healthy newborn piglets, are clinically unaffected.

Differential diagnosis

The differential diagnosis includes porcine parvovirus infection, classical swine fever, porcine reproductive and respiratory syndrome (PRRS), encephalomyocarditis virus infection, Aujeszky's disease (pseudorabies), Japanese encephalitis, swine influenza and blue eye (La Piedad Michoacan) paramyxovirus disease. Non-infectious causes

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of congenital defects, such as toxins or nutritional deficiencies, should also be considered.

Laboratory tests

Menangle virus can be isolated in a wide variety of cell lines; BHK21 cells have been used in the past. Cytopathic effects are seen after 3-5 passages. The virus can be identified in cultures by electron microscopy and virus neutralization. Menangle virus is non-hemagglutinating and nonhemadsorbing, unlike some other paramyxoviruses that can cause reproductive failure in swine.

Serologic tests include virus neutralization and enzyme-linked immunosorbent assays (ELISAs). The most rapid method of excluding Menangle virus is to test sows for specific antibody.

Samples to collect

Before collecting or sending any samples from animals with a suspected foreign animal disease, the proper authorities should be contacted. Samples should only be sent under secure conditions and to authorized laboratories to prevent the spread of the disease. Menangle virus is zoonotic, and precautions should be taken to avoid human infections.

Samples of fetal tissues should be collected for virus isolation and histopathology. Menangle virus is most likely to be found in the brain, lung and myocardium, but it can also be found in other tissues including the kidney and spleen. If possible, some samples should be collected from piglets with gross or histological abnormalities of the brain, as virus isolation is most likely to be positive in these animals. Menangle virus has not yet been isolated from live animals.

Serum should be collected from sows. Neutralizing antibodies may also be found in fluids from the body cavities of some stillborn and aborted fetuses.

Recommended actions if Menangle virus infection is suspected

Notification of authorities

Menangle virus infections must be reported to state or federal authorities immediately upon diagnosis or suspicion of the disease.

Federal: Area Veterinarians in Charge (AVIC):

www.aphis.usda.gov/animal_health/area_offices/

State Veterinarians:

www.usaha.org/Portals/6/StateAnimalHealthOfficials.pdf

Control

In endemic regions, contact between bats and pigs should be prevented. Whenever possible, pig farms should not be built near fruit bat colonies. Flowering or fruiting trees should not be grown near pig farms as they may attract bat activity. Wire screens can help prevent contact with bats when pigs are raised in open-sided pig sheds. Run-off from the roof should be kept from entering pig

pens. In addition, good biosecurity measures may keep Menangle virus and other infections from spreading between farms.

During an outbreak, quarantines can prevent Menangle virus from spreading between farms; in 1997, this virus appears to have traveled between farms in infected pigs. However, because this virus affects only the fetus, the infection may spread through a herd before the symptoms (if any) are seen.

In herds where it has become established, Menangle virus seems to be maintained by infecting 14-16 week old pigs as their maternal immunity wanes. For this reason, the virus can be eradicated from a farm by removing 10-16 week-old pigs, or isolating them for a prolonged period. Alternatively, an infected farm can be depopulated and restocked with unexposed or immune pigs. Menangle virus is thought to survive for only a short period in the environment, and it is expected to be susceptible to many detergents and disinfectants. There is no vaccine.

Public Health

During the 1997 Menangle outbreak, two of 38 people in close contact with infected pigs developed a severe influenza-like illness. Their symptoms included severe headaches, myalgia, lymphadenopathy, fever, drenching sweats and a macular rash. Both recovered after 10 to 14 days. Although these cases were investigated retrospectively, they occurred in the only two people who were seropositive, and appear to have been caused by Menangle virus. Seroconversion was not seen in any other individual; the seroprevalence rate was 5% (2/38) in workers at the affected farms, and less than 1% (2/256) in all exposed individuals including veterinarians, abattoir workers and laboratory workers.

The route of transmission from pigs to humans is not known at this time. As a routine precaution, gloves and other protective clothing should always be used when conducting necropsies, assisting at births or in any other situation where body fluids and tissues could contact skin. Good hygiene can also reduce the risk of zoonotic infections. People who are exposed to infected animals should wear protective clothing, impermeable gloves, masks, goggles and boots. Contaminated skin should be washed promptly and thoroughly.

It is not known whether Menangle virus infections can be acquired by contact with bats or their body fluids; however, there is no evidence that human cases have occurred except during this outbreak. Nevertheless, contact with bats should be avoided whenever possible, and any wounds that could have become contaminated should be washed.

Internet Resources

U.S. Department of Agriculture, Animal and Plant Health Inspection Service. Menangle virus, Australia,

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Emerging Disease Notice.

http://www.aphis.usda.gov/vs/ceah/cei/taf/emergingdiseasenotice_files/menangle.htm

Australian Commonwealth Scientific & Industrial Research Organisation (CSIRO). Hendra, Nipah, Menangle, Tioman Resource List.

<http://www.csiro.au/resources/pfff.html>

Communicable Diseases Network Australia. Australian Bat Lyssavirus, Hendra virus and Menangle Virus Information for Veterinary Practitioners.

[http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/F5614C7988B83121CA256F190003790B/\\$File/batsvet.pdf](http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/F5614C7988B83121CA256F190003790B/$File/batsvet.pdf)

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